# Soil Quality Assessment of Soybean-based Conservation Agriculture Cropping Systems

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## Introduction

Soil quality has been defined as the capacity of a soil to sustain environmental attributes, enhancing biological activities, promoting plant health and increasing crop productivity (Karlen et al., 2003). Assessing soil quality is a significant issue that has been debated in the literature over the last two decades. A set of indicators aiming at assessing three key soil ecosystem functions (i.e., carbon transformation, nutrient cycling and structure maintenance) has been carried out to assess soil quality.

## Research Objective

To assess changes in key soil ecosystem services under direct seeding mulch-based cropping system (DMC) and conventional plow-based tillage cropping system (CT).

## Materials and Methods

This research was conducted in the on-going experiment implemented since 2009 at the Bos Khnor Research Station in Kompong Cham Province, Cambodia (Latitude 12°12'30"N, longitude 105°19'7"E, 118m a.s.l).

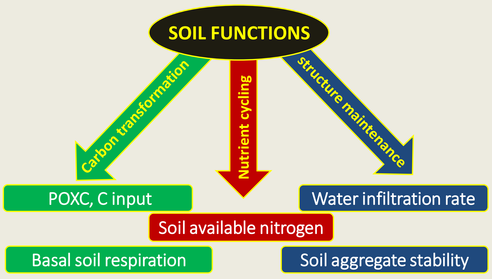
The three-replicated experimental plots in randomized complete block design with four treatments were laid-out in soybean-based cropping systems consisting of

**(i):** Conventional Plow-based Tillage system that soybean is conducted in annual succession with sesame (CT)

**(ii):** Direct Seeding Mulch-based Cropping system in which soybean is grown in a one-year frequency pattern with sorghum and *Stylosanthes guianensis* as main cover crops (DMC1)

**(iii):** DMC2 & DMC3 in which soybean is grown in bi-annual rotation with maize.

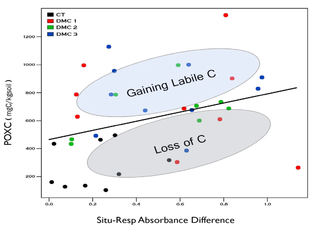
### Data Collection Method

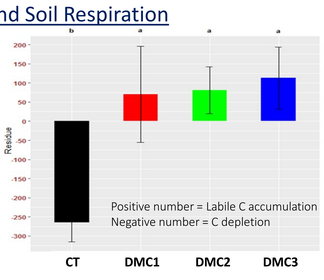



This method was adapted from Thoumazeau et al., 2019.

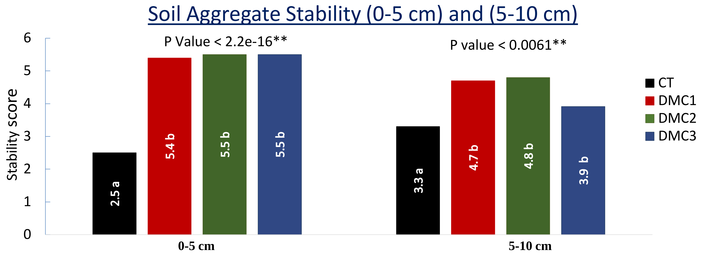
## Results

### Relationship of POXC and Soil Respiration

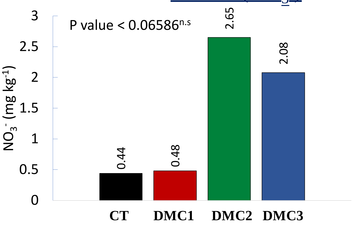


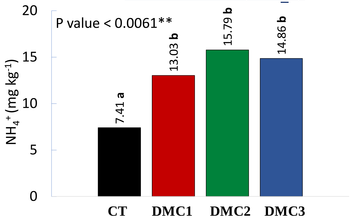

### Soil Aggregate Stability (0-5 cm) and (5-10 cm)




### Nitrate ($NO_3^-$)




### Ammonium ($NH_4^+$)




**CT** = Conventional Plow-based Tillage system where soybean is conducted in annual succession with sesame;
**DMC1** = Direct Seeding Mulch-based Cropping based system in which soybean is grown in a one-year frequency pattern;
**DMC2 & DMC3** = Direct Seeding Mulch-based Cropping system in which soybean is the main crop grown in bi-annual rotation with maize.

## Conclusions

The research was found that the labile-C pool (POXC) and soil respiration significantly increase under DMC systems when compared with CT. The relationship between POXC and soil respiration emphasized a process of C stabilization under DMC systems and a depletion of soil organic C under CT management. Soil aggregate stability was significantly lower under CT.

The research emphasized the positive impacts of DMC systems on key soil ecosystem services improving soil structure, increasing nutrient cycling and thus improving climate change adaptation. Higher stabilization of labile-C pool may also contribute to mitigate climate change.

## References

Karlen, D.L., Ditzler, C.A., Andrews, S.S., 2003. Soil quality: why and how? Geoderma. 114, 145-156.

Thoumazeau, A., Bessou, C., Renevier, M. S., Trap, J., Marichal, R., Mareschal, L., ... & Suvannang, N., (2019). Biofunctool®: a new framework to assess the impact of land management on soil quality. Part A: concept and validation of the set of indicators. Ecological Indicators, 97, 100-110.

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